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1.	Your reference	P016274GB
2.	Patent application number *(The Patent Office will fill in this part)*	0307426.7
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	SONY UNITED KINGDOM LIMITED THE HEIGHTS BROOKLANDS WEYBRIDGE, KT13 0XW UNITED KINGDOM
	Patents ADP number *(if you know it)*	652270001
	If the applicant is a corporate body, give the country/state of its incorporation	UNITED KINGDOM
4.	Title of the invention	ROUTING DATA
5.	Name of your agent *(if you have one)*	D Young & Co
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	21 New Fetter Lane London EC4A 1DA
	Patents ADP number *(if you know it)*	59006

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Statement of inventorship and of right to grant of a patent

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NP10 8QQ

1.	Your reference	P016274GB
2.	Patent application number *(if you know it)*	0307426.7
3.	Full name of the or of each applicant	SONY UNITED KINGDOM LIMITED
4.	Title of the invention	ROUTING DATA
5.	State how the applicant *(s)* derived the right from the inventor *(s)* to be granted a patent	BY VIRTUE OF AN ASSIGNMENT DATED 27 MAY 2003 BETWEEN OURSELVES AND THE OVERNAMED INVENTOR
6.	How many, if any, additional Patents Forms 7/77 are attached to this form? *(see note (c))*	0

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P07/7700 0.00-0307426.7

7\. I/We believe that the person *(s)* named over the page *(and on any extra copies of this form)* is/are the inventor *(s)* of the invention which the above patent application relates to.

Signature D Young & Co   Date 29 May 2003

D Young & Co (Agents for the Applicants)

8\. Name and daytime telephone number of person to contact in the United Kingdom   James Turner   023 8071 9500

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ROUTING DATA

The present invention relates to routing data.

It is known to link video and audio devices in a studio together using a switching device, typically a cross point switch. The present inventors have identified the need for a system which links audio and video devices in a studio by a switched local area network, for example an Ethernet, operating with a known protocol for example with Internet Protocol (IP). However most if not all current video and audio equipment used in studios is not equipped to operate with such a switched network operating according to such a protocol.

The audio and video devices used in a studio include cameras, editors, audio mixers, and VTRs amongst other examples. Some devices receive and/or produce both audio and video data and some, require control data for controlling them. For example VTRs require control data for controlling functions such as play, stop, pause, jog, etc.

It is thus desired to provide a network interface for coupling a video and audio devices to a switched network and which can receive a variety of types of data from the network and provide the variety of types of data to the devices.

According to one aspect of the present invention, there is provided a network interface connectable to a packet-based data network on which a plurality of different types of payload data are distinguished by network-based packet header data;

the network interface comprising:

a plurality of data handling nodes; and

a routing arrangement responsive to a packet identifier for routing data packets between the data handling nodes;

in which:

one of the data handling nodes is a network processor for receiving data packets from and transmitting data packets to the packet-based network; the network processor being operable:

a) in the case of a data packet received from the data network, to detect the type of payload data from the network-based packet header data; to remove the network-based packet header data from the packet; and to associate with the packet an identifier which specifies a route across the routing arrangement to a target data handling node and a data handling operation to be carried out by the target data handling node; and

b) in the case of a data packet received from another data handling node and having an associated packet identifier, to detect the type of payload data from the packet identifier;

removing the packet identifier; applying network-based packet header data in dependence on the packet identifier; and launching the data packet onto the network.

Further respective aspects and features of the invention are defined in the appended claims.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic block diagram of a network in a studio;

Figure 2 is a schematic simplified diagram of the network showing data flows across the network;

Figure 3A is a schematic diagram of the format of an audio or video packet used in the network;

Figure 3B is a schematic diagram of the format of an AVSCP or CNMCP packet used in the network;

Figure 3C schematically illustrates a unicast data packet;

Figure 4 is a schematic block diagram of a network interface of the network of Figure1;

Figure 5A is a schematic diagram of the format of an data packet used in the network interface;

Figure 5B is a schematic example of current flow assignment;

Figures 5C schematically illustrates data flow in an ENIC;

Figures 6A and 6B schematically illustrate a packetiser/depacketiser switch of the network interface;

Figure 7 is a schematic block diagram of an illustrative small network for explaining a mode of operation of the network; and

Figure 8 is a schematic block diagram of a proxy generator of the network interface;

Figure 9 is a schematic diagram of one example of the display of a Graphical User Interface (GUI); and

Figure 10 is a schematic diagram of another example of the display of a Graphical User Interface (GUI);

Figure 11 is a schematic diagram of an example of a graphical interface for illustrating the configuration of the network;

Figure 12 is a schematic diagram of an example of a graphical interface for illustrating how data is routed across the network;

It should be noted that this example of the network operates as follows: a single source device belongs to one and only one multicast group to which it transmits data. A destination device receives data from that source device by joining the source device's multicast group. That is done by issuing a multicast group join message. The invention is not limited to that: other ways of operating are possible.

Overview of ENICs

An ENIC is described in more detail in the section below headed ENIC. An ENIC allows any source group, for example a camera, and any destination group, for example a VTR, which is not designed for use with a multicast network to be used in a multicast network. An ENIC is a "dumb" device which can be requested to supply and receive audio, video, and control data streams. An ENIC cannot view or initiate any change to the configuration of the network. An ENIC may subscribe to one or more multicast groups as directed by the network manager 4.

Each ENIC has an Ethernet address and an IP address. A multicast address and a UDP port are used to identify different data streams and in this embodiment a single IP address is associated with each ENIC. However, in alternative embodiments multiple IP addresses could be associated with a single ENIC. It also has an ENIC identifier ID and port Ids for respective ones of the destination devices and source devices of the ENIC. As will be described those addresses and IDs and other data are recorded with the network manager 4. The source devices and destination devices correspond to respective ones of one or more physical inputs and outputs of an ENIC. The source groups and destination groups may have "tally text" associated with them. An example of tally text is a name such as "VTR1" which may be given to a VTR or a cameraman's name e.g. Jim which may be given to a camera. The tally text is recorded at the network manager. All groups connected to the network may be named in this way. Source devices may have tally text, termed sub_tally herein, associated with them.

An ENIC acts as a switch which switches data received from the switch 2 to a specified physical output of the ENIC and switches data from a specified physical input to the switch 2.

The network, implemented using the switch 2, is asynchronous, but video and audio needs synchronous processing. The video and audio devices connected to the network operate on serial digital data, for example SDI. The ENICs convert serial digital video and audio to multicast UDP/IP packets and convert multicast UDP/IP video and audio packets to serial digital video and audio. The ENICs also provide synchronous operation over the

2.DESTINATION device:: Video, Audio and Status is received from the network by joining a multicast group.

3.CONTROL_SOURCE device: Control commands are generated by an ENIC or Client and are transmitted unicast to a CONTROL_DESTINATION.

4.CONTROL_DESTINATION device: Receives control commands unicast from a CONTROL_SOURCE.

The client 6 cannot directly access the SOURCE and CONTROL_DESTINATION devices. These devices are members of a CONTROL_SOURCE_GROUP, a structure that groups devices that cannot be controlled independently. For example, SDI outputs from a VTR are connected to an ENIC for transmission onto the network 2. The SDI input is represented as two SOURCE devices *(V_o, A_0,)* in the network configuration. All of these devices are from the same physical device, are jointly controlled and have a common time code and stream status, i.e. stop, FF(fast forward), rew (rewind), etc.

A predetermined set of information is stored in relation to each of the above device types, for example a device identifier, a destination IP address associated with the device and a UDP port and/or IP address of an ENIC associated with the device.

A predetermined set of information associated with an ENIC known as an ENIC structure is held in a database in the network manager and comprises the Ethernet address and IP address of the ENIC. The ENIC structure also maps the associated devices (e.g. audio and video streams) to the physical ports on the card and includes any hardware limitations that restrict the ideal model described above. When an ENIC starts up it will receive information on what devices are connected to its RS422 ports (i.e. VTR, TALLY), so that the correct driver can be used.

<u>Overview of Switching and Routing Client 6.</u>

There may be one or more clients 6, 61 connected to the network but the following description assumes there is only one. The network manager 4 provides the client 6 with information specifying the configuration of the network. The client 6 can initiate a connection between a source device and a destination device across the network. All requests for initiating such changes to the configuration of the network are sent to the network manager 4. Control data which does not change the configuration of the network may be issued by the client 6 directly to an ENIC and, via ENIC, a group associated with the ENIC.

instruction between the ENIC and the switching control server 6 is sent via the AVSCP protocol.

AVSCP has five main functions which are to:

1) Monitor the operational status of the ENICs;

2) Discover the configuration of an ENIC;

3) Stop and start audio and video source transmission;

4) Direct ENICs and their associated audio and video devices to join multicast groups; and

5) Set up and tear down paths for conveying control data across the network.

The network manager 4 should be aware of the operational status of an ENIC before it can send any instructions to it. Accordingly the AVSCP requires an ENIC to send status messages to the server periodically. The network manager 4 can only control AV stream transmission and reception of an ENIC when it is operational. The network manager 4 can alternatively obtain the current configuration of an ENIC by sending a configuration request message to it. The ENIC responds by returning a message specifying the current configuration.

Figure 14 schematically illustrates how AVSCP relates to other functional modules in an ENIC network protocol stack. The arrangement of Figure 14 shows identical protocol stacks of two different ENICs 1100A and 1100B and a protocol stack of the network manager 1120. The ENIC protocol stack comprises an AVSCP layer 1104 that sits on top of a UDP/IP/Ethernet layer 1102. Other protocols 1106 may also be implemented at the same level of the protocol stack as AVSCP. The AVSCP layer communicates with a higher layer comprising ENIC applications via an AVSC_request command and an AVSC_indicate command. An uppermost layer of the ENIC protocol stack 1100A represents a local configuration 1110 of the network. The network manager protocol stack 1120 is similar to the ENIC protocol stack 1100A in that it comprises an AVSCP layer 1124 that sits on top of a UDP/IP/Ethernet layer 1122. However, a server applications layer 1128 sits on top of the AVSCP layer 1124 and communications between these two layers are mediated by the AVSC_request command and the AVSC_indicate command. The server applications layer 1128 is in communication with a higher layer corresponding to a network configuration database 1130. The AVSCP protocol layer of the ENIC 1104 may send AVSCP protocol messages to the corresponding AVSCP protocol layer 1124 of the network manager.

The AVSCP_request is a primitive command that is sent from the application layer 1108, 1128 to the AVSCP protocol layer 1104, 1124. An application initiates an AVSCP_request in order to send an AVSCP message to another AVSCP entity. The AVSCP

associated with the ENICs which are connected to the network and data associated with source devices and destination devices connected to the network by the ENICs. By sending CNMCP messages to the client, the network manager 4 informs the client of the multicast IP addresses on which it can receive the proxy video streams, audio streams and status streams. The network manager can determine whether sufficient bandwidth is available to service a client request and mediates access to network resources accordingly. However, it is also possible for the client to join a multicast group directly without requesting access via network manager. This may be appropriate where, for example, the client requires only a low data-rate connection.

Alternatively to CNMCP, a known protocol such as Simple Network Management Protocol (SNMP) may be used. The client 6 can cause the network to connect Audio and Video streams from source devices specified by the client to destination devices specified by the client and to specify control data routing by sending CNMCP or SNMP messages to the network manager.

Audio and Video Data (RTP)

For sending streams of audio and video data from the sources to the destinations, the transport layer is UDP multicast. The audio and video data are carried in Real-Time Protocol (RTP) format within a UDP packet. This applies to the audio data, the full resolution video and the low resolution proxy video. (See Section Data Format and Figure 3A below for a description of the data format). RTP provides functions to support real-time traffic, that is, traffic that requires time-sensitive reproduction at the destination application. The services provided by RTP include payload type identification (e.g. video traffic), sequence numbering, time-stamping and delivery monitoring. RTP supports data transfer to multiple destinations via multicast distribution if provided by the underlying network. The RTP sequence numbers allow the receiver to reconstruct the original packet sequence. The sequence numbers may also be used to determine the proper location of a packet. RTP does not provide any mechanism to ensure timely delivery, nor does it provide other Quality of Service guarantees.

When an ENIC receives an AVSCP switch request from the network manager 4, the ENIC sends an IGMP join message to the switch 2 to join the multicast group of the data it needs to receive.

Unicast Control Data (UCD)

low-order 23 bits of the Ethernet address. Accordingly 5 bits of the multicast group ID are not used to form the Ethernet address. As a consequence the mapping between the IP multicast address and the Ethernet address is non-unique i.e. 32 different multicast group IDs map to the same Ethernet address.

The UDP header comprises source and destination port numbers, which are typically associated with a particular application on a destination device. Note that UDP is redundant in the case of multicast messages since in this case the multicast group address identifies the stream/content. The audio/video streams are transported using RTP protocol. Forward Error Correction (FEC) may be used for certain data streams e.g. full resolution video streams to provide a level of protection against data corruption due to network errors. FEC is provided using a known RTP payload format that provides for FEC. FEC is a parity-based error protection scheme. A known extension to the RTP protocol allows a video scan line number to be specified in the RTP payload header. The RTP header also comprises a field to specify whether 8-bit or 10-bit video is present. Although known RTP and RTP/FEC protocol formats provide the data packet fields necessary to transport audio and video data over an IP network it may also be desired to transmit additional information such as source status and source timecode information. For example if the source is a VTR then the timecode as stored on the tape should be transferred across the network. The source status information might indicate, for example, whether the VTR is currently playing, stopped or in jog/shuttle mode. This status information allows a user to operate the VTR from a remote network location. Since the timecode data and source status information is required only once per field, the information is transported in an RTP packet marked as vertical blanking. To allow audio and video resynchronisation, the RTP timecode is based on a 27MHz clock. The payload type field contains data indicating the type of payload. i.e. video or audio. The payload field contains the video or audio data. The CRC is a cyclic redundancy check known in the art.

<u>AVSCP and CNMCP</u>

AVSCP and CNMCP messages are carried by a data format as shown in Figure 3B. The format comprises in order, an Ethernet header, an IP header which is not a multicast header), a UDP or TCP header, the payload, and a CRC field. The Ethernet header comprises source and destination Ethernet addresses. The IP header comprises the source ENIC IP address and the destination ENIC IP address. UDP is used for AVSCP and TCP is used for CNMCP. The payload field contains the AVSCP or CNMCP message. The CRC is a cyclic redundancy check known in the art.

The packetiser/depacketiser has 3 video inputs 218 for receiving respective SDI video streams, 3 audio inputs 220 for receiving respective audio streams. Alternatively, three input ports could be provided for receiving combined SDI audio/video streams and the audio and video streams could be subsequently separated to form 3 audio and 3 video streams with in the ENIC The packetiser/depacketiser 24 has likewise 3 video outputs 222 and 3 audio outputs 224.

The CPU 26 has 3 control data inputs 226 and 3 control data outputs 228.

The three video inputs 218 are connected to respective ones of three substantially real-time proxy video generators 212 which generate the low resolution versions of the video streams as will be described below. The outputs of the proxy generators and the inputs 218 are connected to a packetiser and multiplexer 214, which converts the full resolution serial video from the inputs 218 and the proxy video from the proxy generators 212 to packets. The packets are supplied to the packet switch 22. The packetiser/depacketiser 24 has a depacketiser 216 and demultiplexer for receiving packets representing the video and audio channels from the packet switch 22. It depacketises and demultiplexes the video and audio into 3 serial video streams and 3 serial audio streams for supply to respective ones of 3 video outputs 222 and 3 audio outputs 224. Thus the packetiser/depacketiser 24 provides routing of the video and audio received from the packet switch 22 to outputs 222 and 224 and routing of the video and audio received from the inputs 218 220 to the switch 22. The packetiser/depacketiser 24 also provides synchronisation of the different video and audio streams in conjunction with the clock synchronisation circuit 204 and frame alignment of the video frames of the different video streams in conjunction with the frame synchronisation circuit 205.

The packet switch 22 provides routing of video, audio and control packets received from the network processor 20 in accordance with tags applied to the packets in the network processor 20. The network processor 20 generates the tags in accordance with header data in the received packets. There are two sorts of tag: a "flow" tag which defines the route through the packet switch 22 and a "type" tag which defines the final output to which the packets are supplied by the packetiser/depacketiser 24. The video and audio packets are routed to the depacketiser 216 and the control packets are routed to the CPU 26. The CPU provides 3 control data channels 228 here denoted "*RS422*" because they provide control similar to that provided by RS422 in a conventional studio. CPU 26 also receives 3 control data channels 226.

video data payload of Figure 3A. In the case of AVSCP/CNMCP data packets and unicast control data packets (see Figures 3B and 3C) the tagged packet payload is the message data.

The flow data field defines the output of the packet switch 22 (Figure 4) corresponding to the target data-handling node for which the tagged packet payload is destined. The type data field determines what the target processor does with the data and the size data field specifies the payload size.

Figure 5B schematically illustrates an example of a flow assignment allocation. In this example flow 0 corresponds to data that will not be passed to any target processing device e.g. untagged data; flows 1 and 4 correspond to video input and output ports 218, 222 (see Figure 4); flows 2 and 5 correspond to CPU data flows from and to the network; and flows 3 and 6 correspond to PCI data flow from and to the network.

Figure 5C schematically illustrates how video data, PCI data, network data and CPU data is mapped to each of the six defined flow paths via multiplexers (MUX) and demultiplexers (DEMUX). Each of the data flows of Figure 5B is associated with a FIFO. There is no direct means of determining the size or number of packets written to the FIFO since this is not necessary. The tags associated with the packets specify the packet size so only a "not empty" indication for the FIFO is required by a MUX to perform a read operation. The MUX modules are programmable (by external means such as a CPU) such that they are sensitive only to particular flows. This enables virtual flow paths to be set up across the buffer and packet switch 22 of Figure 4. Similarly, to avoid contention, only a single DEMUX module can write into any one data flow. Again, the mapping is programmably controlled by external means.

Referring to Figure 6A, the video section of the packetiser/depacketiser 24 is shown. It comprises a demultiplexer 2401 which responds to the "type" data in the tags attached to the video packets to feed video packets to three channels V0, V1 and V2 denoted by the type data. Each channel comprises an RTP/FEC decoder 2402, 2403, 2404 followed by a frame store 2405. The RTP decoder 2402 removes the tag from the packet it receives and writes the packet into the frame store at the address defined by the RTP packet header, in particular the line number data thereof, to create a video frame having the video data in the correct order.

Example of operation 1

processing operation. A pure source is a source that supplies to the network for the first time.

The video source device for each camera is a 'pure' source. Each camera has a user group called "Producer" and the Producer has set the tally tag to be the name of the cameraman, i.e. FRED or JIM. There are three other ENICs on the network. The first performs a visual effect on the video from 'Camera 1' and is called ENIC_DME since it performs digital multi-effects (DME). This ENIC will have two device entries in the database, called 'DME In' and 'DME Out'. 'DME In' is a destination device, which has a video link to 'DME Out'. 'DME Out' is a source device, which has a video link to 'DME In' and transmits onto the network. 'DME Out' also has a tally entry of El (indicating EFFECT 1). The second ENIC performs a seamless switch between two sources and is called ENIC_AB_SWITCH. This ENIC will have three device entries in the database, called 'Switch A In', 'Switch B In' and 'Switch Out'. 'Switch Out' is a source device that will either be linked to 'Switch A In' or 'Switch B In', depending on which video source is selected. The third ENIC is called ENIC_AIR and has one device called 'Monitor' (a monitor with a tally). 'Monitor is a 'pure' destination device (LINKED = 0) that receives video from the AB switch. It also has a tally that displays the METADATA from its source device, 'Switch Out'.

Say that the AB switch is showing channel A and the METADATA of Camera 1 changes. Maybe ROB replaces FRED. A request will be sent to the Network Manager to changed FRED to ROB. The Network Manager will examine each destination Device that is subscribed to Camera 1's multicast group and update the view of any client that is displaying it. If any of these destination devices is a linked device, then it must navigate to the corresponding linked source device and update all of its destinations, and so on. In the scenario above, 'DME In' is the only destination device and it is linked to 'DME Out'. 'DME Out's' METADATA (El) is concatenated to ROB to form ROB_El and all of its destinations must be notified. The only destination device is 'Switch A In'. Since the switch is showing channel A, 'Switch A In' is a linked destination device and we must update all destinations of its corresponding source device ('Switch Out'). 'Switch Out' only has one destination and this is a pure destination 'Monitor'. The tally of 'Monitor' is updated with 'ROB_El'.Another scenario is when we perform an AB switch. A request will be sent to the Network Manager to perform a seamless AB switch between devices 'Switch A In' and 'Switch B In'. If the network has been configured correctly, as above, then this is allowed. Since SRC_DEVICE of 'Switch B In' references 'Camera 2', we can navigate to 'Camera 2'

either the proxy video stream or the higher-resolution SDI video stream could be assigned to different multicast groups.

In a currently preferred example of the invention, the proxy video comprises180 samples × 144 lines (PAL) or 180 samples ×120 lines (NTSC) and 25 or 30 frames per second, with horizontal and vertical filtering. The number of bits per sample may be 24 bits (i.e. 3 colours, each 8 bits) or 16 bits (i.e. 3 colours, each 5 bits).

Switching and routing client 6

Referring to Figures 9 and 10, examples of graphical user interfaces (GUI) are shown. In this example of the invention, the GUI is provided by the switching and routing client 6. However the GUI may be provided by the network manager 4 or by both the network manager 4 and the switching and routing client 6. The GUI is an interface with underlying software which reacts to actions taken by the user using the GUI.

Data flows

The GUI displays information about the configuration of the network provided to it by the network manager 4. That information is provided using the CNMCP protocol as discussed above. The GUI also displays proxy video provided by the ENICs using the Real Time Transport protocol described above. The proxy video is multicast and to receive it the switching and routing client joins the multicast groups of the proxy video streams. The routing of data is established using IGMP message commands. The GUI may be used to initiate control of a controllable group such as a VTR. The switching and routing client 6 unicasts control data directly to the ENIC associated with the controlled group in response to an action taken via GUI. Unicast control data is described above. The switching and routing client receives status stream data which is multicast as described above and the client joins the multicast group thereof.

When the GUI is used to initiate a routing of video from a source device to a destination device, it sends an CNMCP message to the network manager 4. The network manager sends an AVSCP message to the ENIC associated with the destination device to cause it to join the destination device to the required multicast group.

The client 6 is able to send IGMP join messages to the network. However, the client may also self-subscribe to a multicast group for communication of status, audio and proxy data streams only. The network manager controls client access to a multicast group corresponding to a video stream. The GUI

the source device.

If the client is not permitted to perform this operation then the Network Manager will send a CNMCP NAK message to the client in response. Otherwise it will process the request as follows.

The Network Manager will examine the database and determine which multicast IP address the video is being transmitted to. An AVSCP Switch message will be created that contains this IP address and it is sent to the ENIC, which connects the Monitor. The ENIC embedded software sends an IGMP Join message to this IP address and sends an AVSCP ACK message back to the Network Manager. The ENIC should now be receiving the desired video data and will send it to the SDI output that connects the Monitor. Meanwhile, the Network Manager, having received the AVSCP ACK message, will update the routing information in the database. The Network Manager sends a CNMCP ACK message back to the client to indicate success.

The GUI of Figure 9 preferably also includes, as shown, two further display areas M1 and M2 showing the video displayed on play-out monitors MON 1 and MON2. In this example MON2 has a dark border indicating that it shows the video being played out on LINE OUT 1 from for example VTR1. MON 1 which has a lighter border shows the video from CAM1 which has been preselected for play-out next. The video may be selected for display in the windows MON1 and MON2 by dragging and dropping proxy video from windows W1 to W10 into MON 1 and MON 2. The video to be played out may be selected by clicking on MON1 or MON2.

The GUI of Figure 9 has an audio control display area AUD.

The GUI also has virtual controls C1 to C10 associated with the windows W 1 to W10 and controls CM associated with the MON1 and 2 windows. Operation of such a control causes the underlying software to send unicast control data UCD across the network directly to the source group from which the video in the associated window originates. Alternatively, or in addition, C1 to C10 can indicate the current status of the relevant device.

The GUI of Figure 10 differs in minor ways from that of Figure 9. It has proxy video display areas W1 to W8, a network management area A1 (shown only schematically) identical to that of Figure 9, and monitor displays M1 and M2. The GUI of Figure 10 lacks the rows of source and destination buttons, but has two buttons M1 and M2 which act, like the buttons of Figure 9, as switches. The buttons M1 and M2 select for play-out video associated with an associated one of windows M1 and M2. The played out video is displayed in a play-out window MP.

both DSP 2 and DSP 3. The names of the sources e.g. CAM 1, VTR 1, MIC 1 are derived from the tally text.

Figure 12 schematically illustrates a GUI that provides the user with an overview and an interface for displaying to an operator how the data is being routed across the network. The GUI comprises a routing review overview panel 121 at the top of the screen and a main routing review panel 122 comprising a source sub-panel 123 and a destination sub-panel 124. The overview routing review panel 121 provides an easily comprehensible overview of the relationships between sources and destinations. This is achieved by colour-coded highlighting. This panel 121 currently indicates that source CAM1 is connected to destinations MON1, MON2, MON3, VTR2 and AUOUT3. By clicking on a given source area of the routing review overview panel 121, that source and any destinations associated with it are highlighted. The sources sub-panel 124 provides an expanded view of the source in which both the source group e.g. CAM1 and the associated device V1 or V2 are graphically represented. Similarly, the destinations sub-panel provides an expanded view of the destination groups. From the highlighted areas in the sources sub-panel 121 and the destinations sub-panel 124 it is apparent that CAM1 device V1 is connected to devices V1 and V2 of MON1 for example. The destination sub panel 124 also provides a graphical colour coded matrix representation of source-destination connections.

Figure 13 schematically illustrates a user interface provided on the network manager via which a user may manually enter configuration data. When a device is connected to the network, the user informs the network manager that this is the case via the user interface. The interface comprises an ENIC ID dialog box, a PORT ID dialog box and a TALLY TEXT dialog box. The user enters into dialog boxes data required by the manager to determine the configuration of the network. The ENIC ID entry is a user-defined identifier e.g. ENIC6, the PORT ID entry specifies the ENIC port to which the device has been connected and the TALLY TEXT entry specifies the freely assignable label (referred to above as tally text) used as a source/destination identifier. The tally text ID is used in addition to (rather than as an alternative to) the source and destination identifiers ID discussed above.

References.

1, RTP Payload Format for BT.656 Video Encoding, D. Tynan, (Claddagh Films) RFC2431, Oct. 1998.

5. A network interface according to claim 4, in which the routing arrangement comprises a demultiplexer for demultiplexing different types of packets to different routing paths in dependence on the type identifier.

6. A network interface according to claim 5, in which a respective multiplexer is associated with each data handling node, each multiplexer being arranged to receive data packets from the routing paths which have that data handling node as a target node.

7. A network interface according to any one of claims 4 to 6, in which:

the types of payload data include audio data and video data; and

one of the data handling nodes is an audio/video processor for extracting audio and/or video data from a packet payload and generating an output audio and/or video signal.

8. A network interface according to claim 7, in which:

in the case of a data packet received from the data network having an audio or video data payload, the network processor is arranged to associate with the packet an action identifier which specifies whether the payload comprises audio or video data and a type identifier specifying the audio/video processor as the target data handling node; and

the audio/video processor processes the data packet as audio data or as video data in dependence on the action identifier.

9. A network interface substantially as hereinbefore described with reference to the accompanying drawings.

10. A method of operation of a network interface connectable to a packet-based data network on which a plurality of different types of payload data are distinguished by network-based packet header data; the network interface comprising a plurality of data handling nodes; and a routing arrangement responsive to a packet identifier for routing data packets between the data handling nodes; in which one of the data handling nodes is a network processor for receiving data packets from and transmitting data packets to the packet-based network; the method comprising the steps of:

a) in the case of a data packet received from the data network, detecting the type of payload data from the network-based packet header data; removing the network-based packet header data from the packet; and associating with the packet an identifier which

ABSTRACT

ROUTING DATA

A network interface connectable to a packet-based data network on which a plurality of different types of payload data are distinguished by network-based packet header data; comprises:

a plurality of data handling nodes; and

a routing arrangement responsive to a packet identifier for routing data packets between the data handling nodes;

in which:

one of the data handling nodes is a network processor for receiving data packets from and transmitting data packets to the packet-based network; the network processor being operable:

a) in the case of a data packet received from the data network, to detect the type of payload data from the network-based packet header data; to remove the network-based packet header data from the packet; and to associate with the packet an identifier which specifies a route across the routing arrangement to a target data handling node and a data handling operation to be carried out by the target data handling node; and

b) in the case of a data packet received from another data handling node and having an associated packet identifier, to detect the type of payload data from the packet identifier; to remove the packet identifier; to apply network-based packet header data in dependence on the packet identifier; and to launch the data packet onto the network.

(Fig. 4)

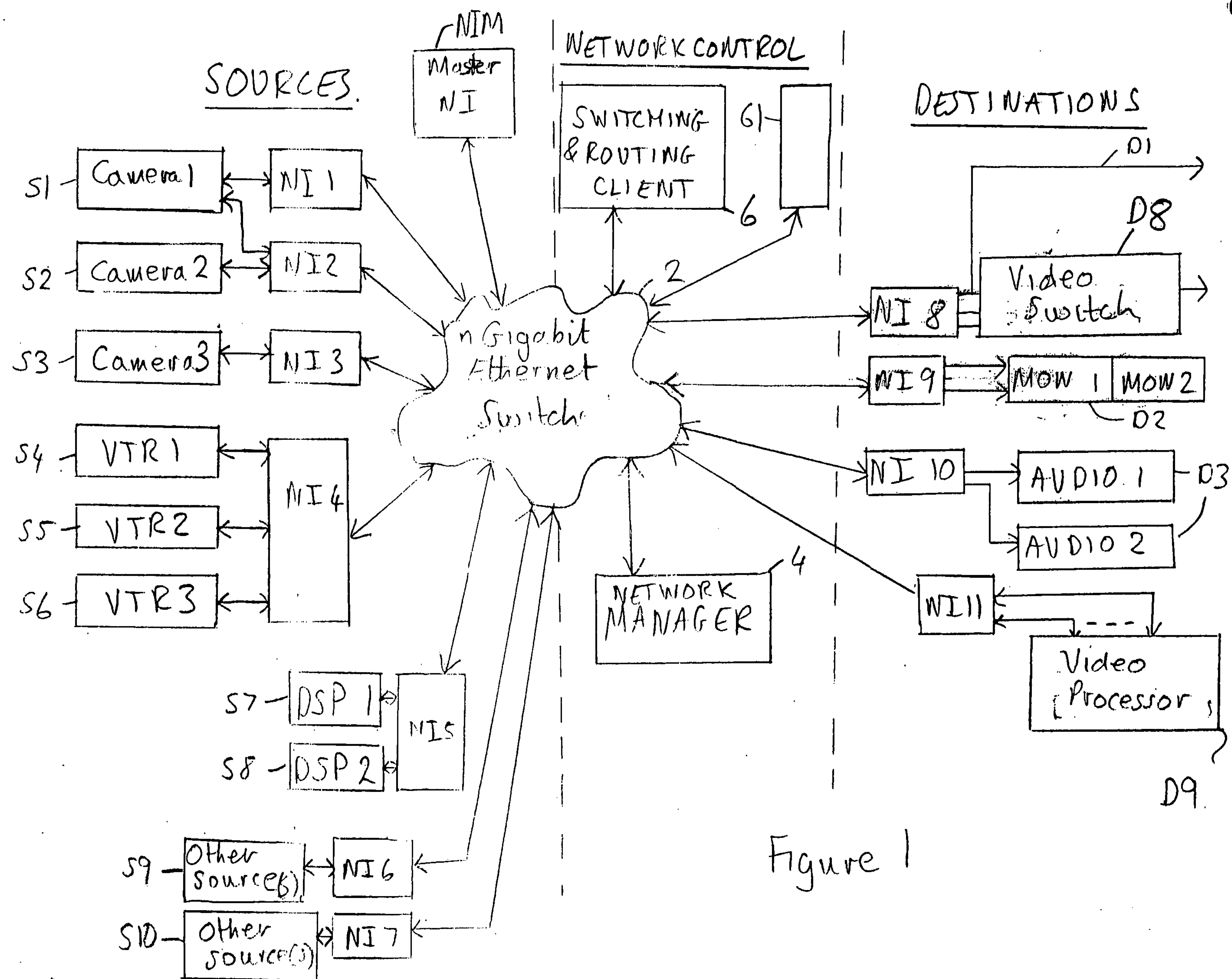


Figure 1

I-02-134.

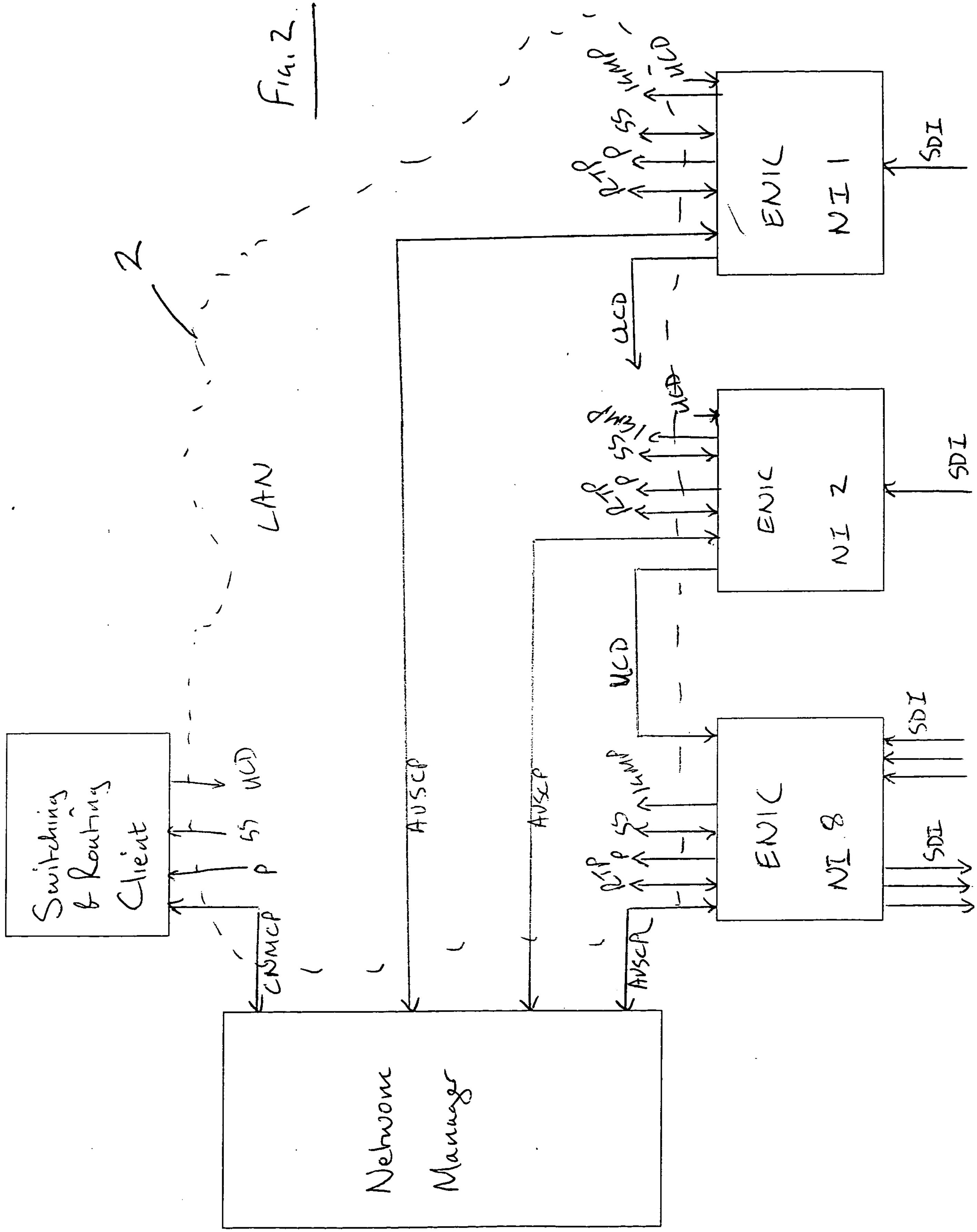

2
LAN
Switching & Routing Client
Network Manager
ENIC NI 1
ENIC NI 2
ENIC NI 8
RTP
SS
IGMP
UCD
CNMCP
AVSCP
SDI

Fig. 2

ETHERNET HEADER	IP MULTICAST HEADER	UDP HEADER	RTP	PAYLOAD TYPE	AUDIO/VIDEO PAYLOAD DATA	CRC

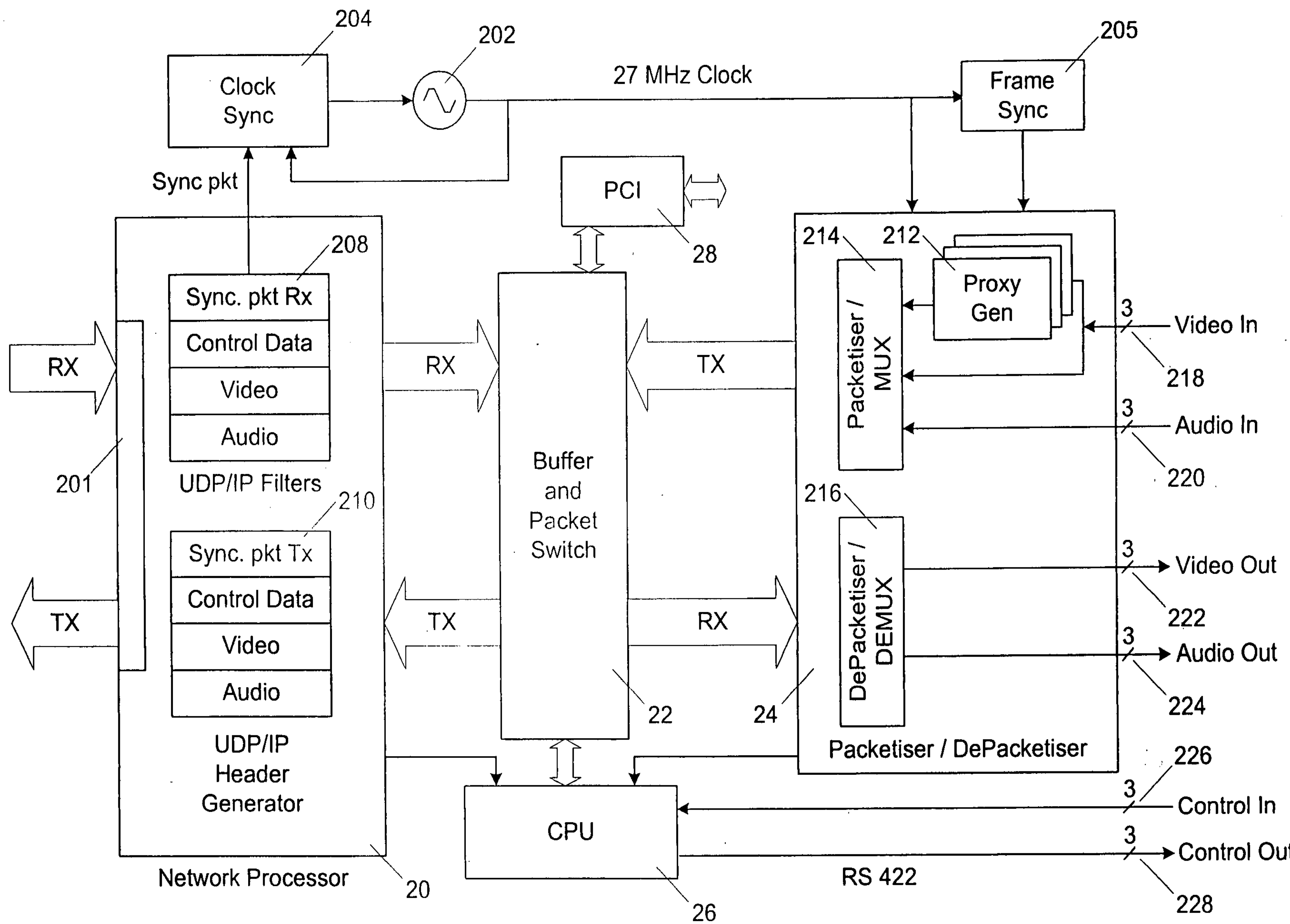
FIG 3A AUDIO/VIDEO

ETHERNET HEADER	IP HEADER (NOT MULTI-CAST)	UDP/TCP HEADER	MESSAGE	CRC

FIG 3B AVSCP/CNMCP

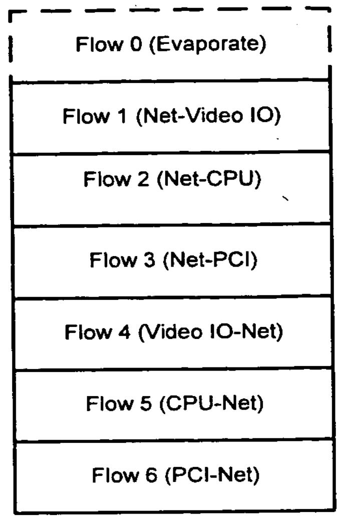
ETHERNET HEADER	IP HEADER (NOT MULTICAST)	UDP	MESSAGE	CRC

FIG 3C



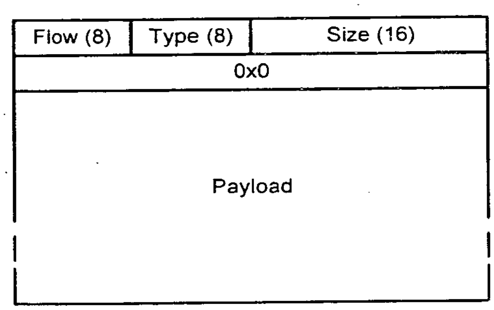
Clock Sync
204
202
27 MHz Clock
Frame Sync
205
Sync pkt
PCI
28
Sync. pkt Rx
Control Data
Video
Audio
208
UDP/IP Filters
Sync. pkt Tx
Control Data
Video
Audio
210
UDP/IP Header Generator
Network Processor
20
RX
TX
201
RX
TX
Buffer and Packet Switch
22
TX
RX
214
212
Proxy Gen
Packetiser / MUX
216
DePacketiser / DEMUX
Packetiser / DePacketiser
24
3
Video In
218
3
Audio In
220
3
Video Out
222
3
Audio Out
224
226
3
Control In
3
Control Out
228
RS 422
CPU
26

FIGURE 4



Example of the current flow assignment

FIG 5B



Example of a packet with a tag

FIG 5A

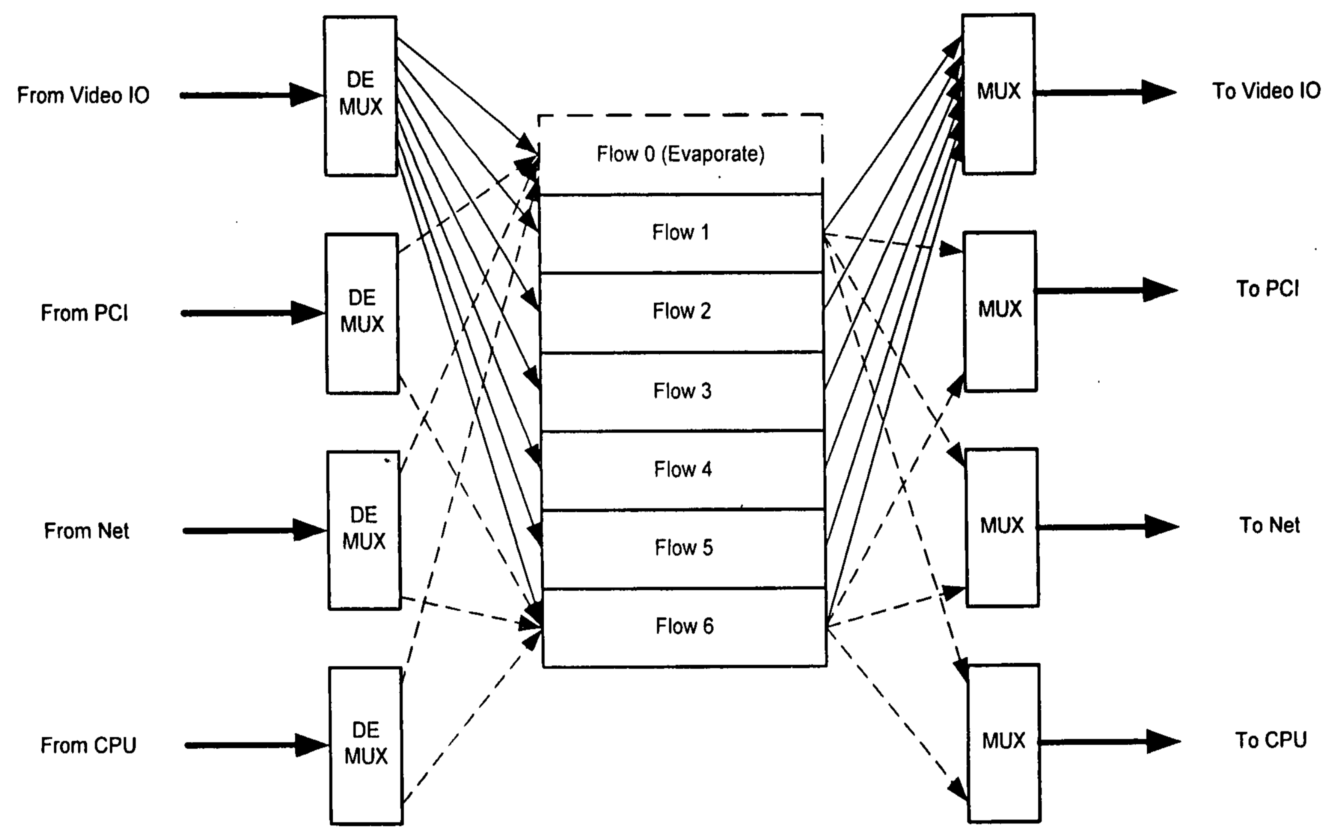

From Video IO
From PCI
From Net
From CPU
DE MUX
DE MUX
DE MUX
DE MUX
Flow 0 (Evaporate)
Flow 1
Flow 2
Flow 3
Flow 4
Flow 5
Flow 6
MUX
MUX
MUX
MUX
To Video IO
To PCI
To Net
To CPU

FIG 5C

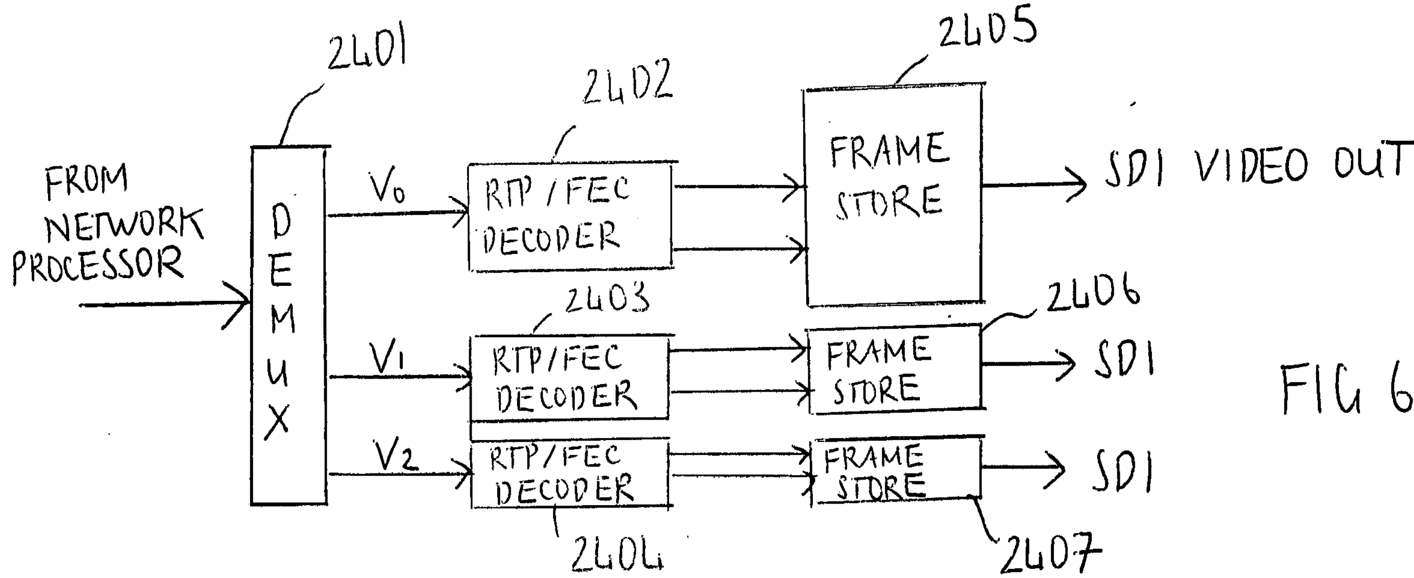

FROM NETWORK PROCESSOR
DEMUX
2401
V_0
V_1
V_2
RTP/FEC DECODER
2402
2403
2404
FRAME STORE
2405
2406
2407
SDI VIDEO OUT
SDI
SDI

FIG 6A

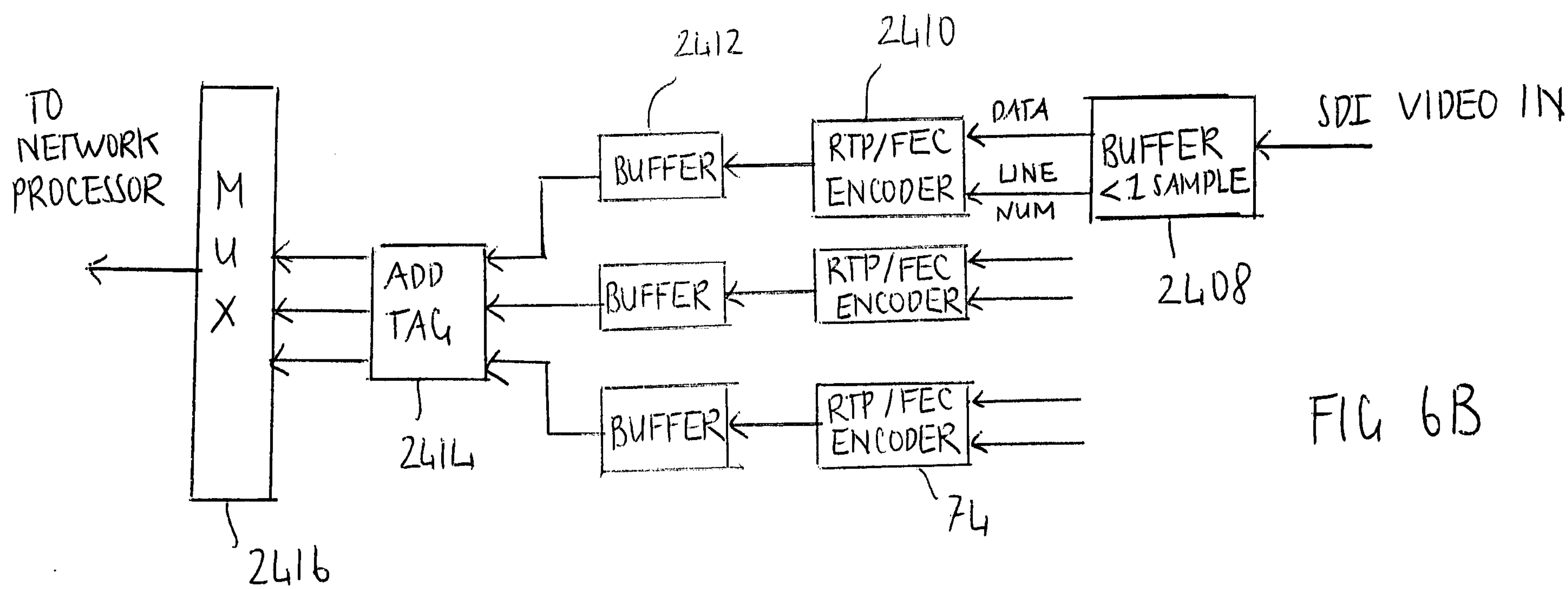

SDI VIDEO IN
BUFFER <1 SAMPLE
2408
DATA
LINE NUM
RTP/FEC ENCODER
2410
74
BUFFER
2412
ADD TAG
2414
MUX
2416
TO NETWORK PROCESSOR

FIG 6B

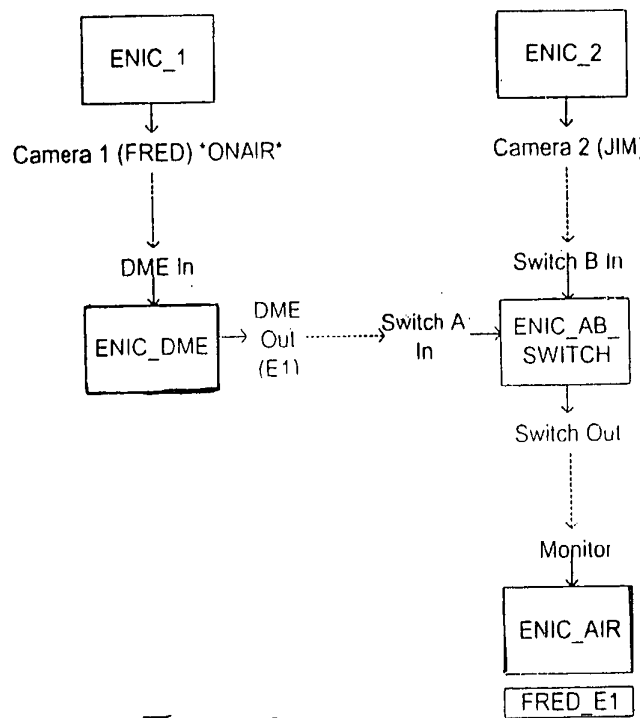

ENIC_1
Camera 1 (FRED) *ONAIR*
DME In
ENIC_DME
DME Out (E1)
Switch A In
ENIC_2
Camera 2 (JIM)
Switch B In
ENIC_AB_SWITCH
Switch Out
Monitor
ENIC_AIR
FRED_E1

Figure 7

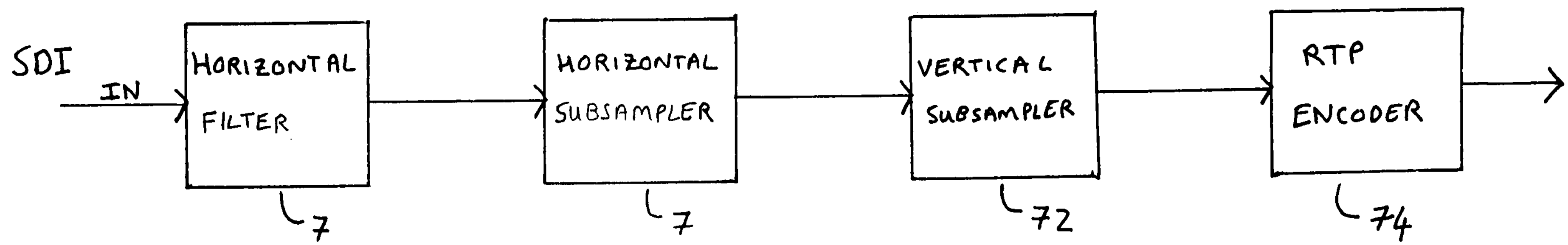

SDI
IN
HORIZONTAL
FILTER
7
HORIZONTAL
SUBSAMPLER
7
VERTICAL
SUBSAMPLER
72
RTP
ENCODER
74

Figure 8

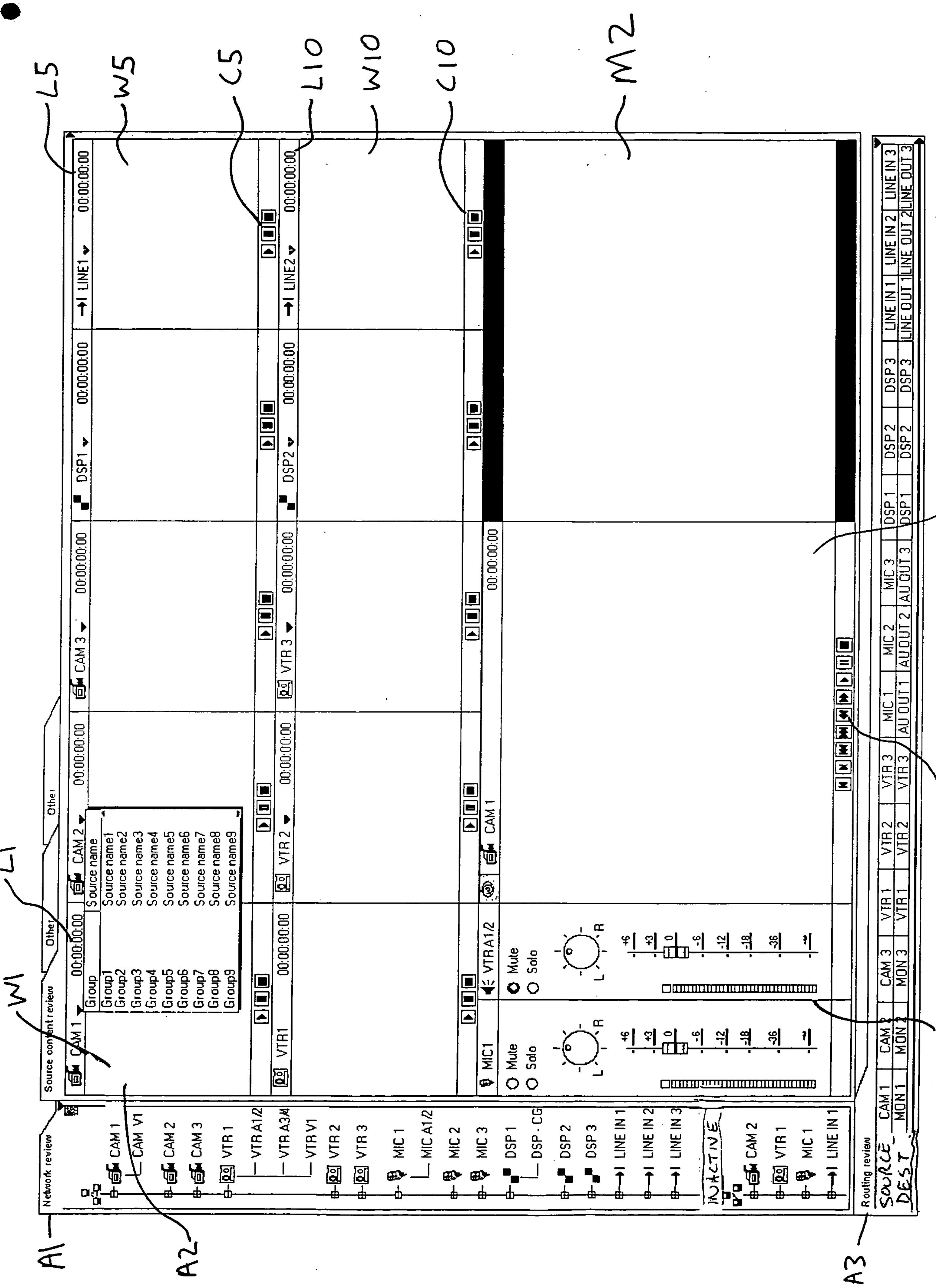

A1
A2
A3
W1
L1
L5
W5
C5
L10
W10
C10
M2
M1
CM1
AVD
Network review
Source content review
Other
Routing review
CAM 1
CAM V1
CAM 2
CAM 3
VTR 1
VTR A1/2
VTR A3/4
VTR V1
VTR 2
VTR 3
MIC 1
MIC A1/2
MIC 2
MIC 3
DSP1
DSP - CG
DSP 2
DSP 3
LINE IN 1
LINE IN 2
LINE IN 3
INACTIVE
00:00:00:00
DSP1
LINE1
DSP2
LINE2
Group
Group1
Group2
Group3
Group4
Group5
Group6
Group7
Group8
Group9
Source name
Source name1
Source name2
Source name3
Source name4
Source name5
Source name6
Source name7
Source name8
Source name9
MIC1
VTR A1/2
Mute
Solo
L
R
+6
+3
0
-6
-12
-18
-36
SOURCE
DEST
MON 1
MON 2
MON 3
AU OUT 1
AU OUT 2
AU OUT 3
LINE OUT 1
LINE OUT 2
LINE OUT 3

FIG 9

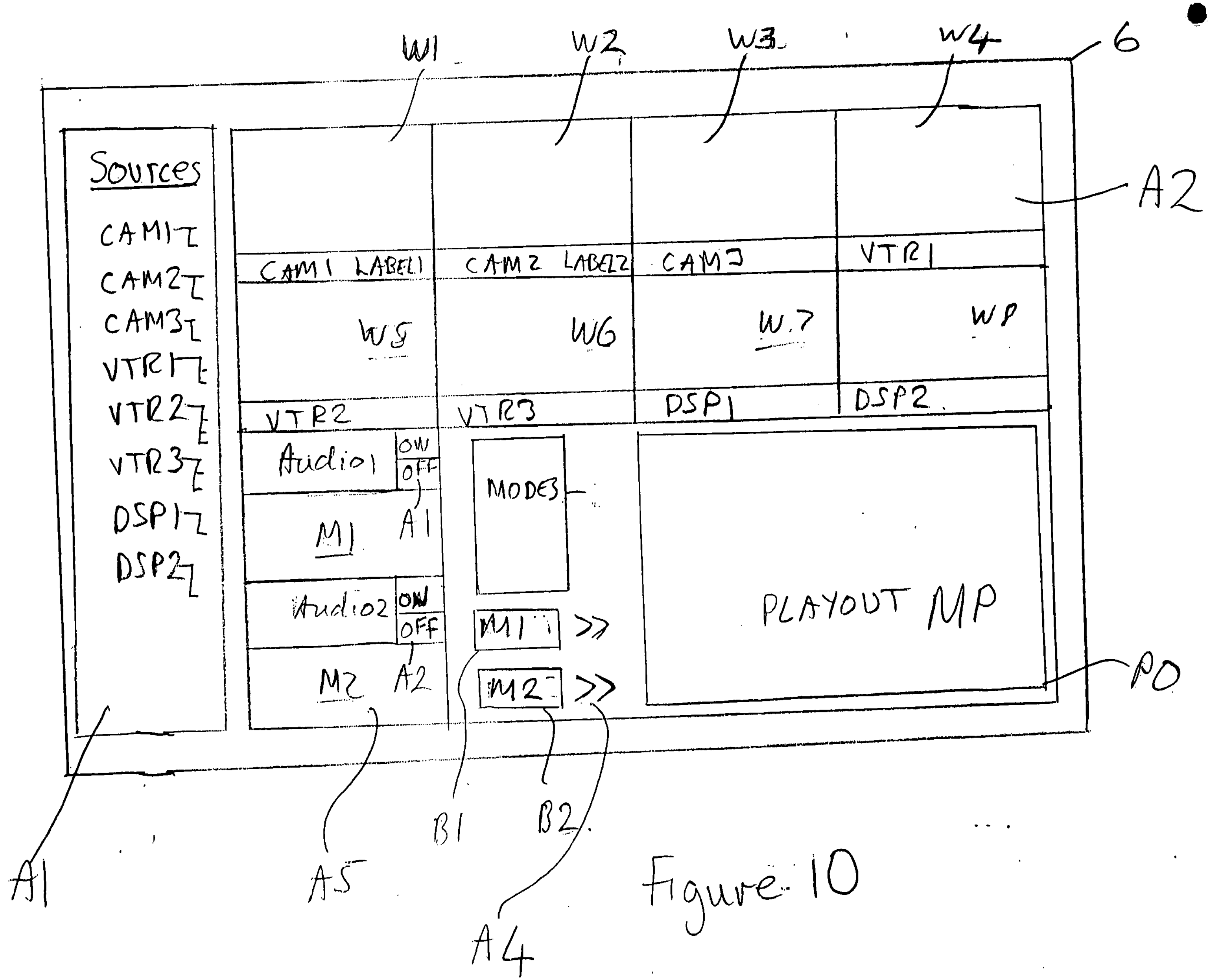

W1
W2
W3
W4
6
A2
Sources
CAM1
CAM2
CAM3
VTR1
VTR2
VTR3
DSP1
DSP2
CAM1 LABEL1
CAM2 LABEL2
CAM3
VTR1
W5
W6
W7
W8
VTR2
VTR3
DSP1
DSP2
Audio1
ON
OFF
A1
M1
Audio2
ON
OFF
A2
M2
MODES
M1
M2
PLAYOUT MP
PO
A1
A5
B1
B2
A4

Figure 10

10

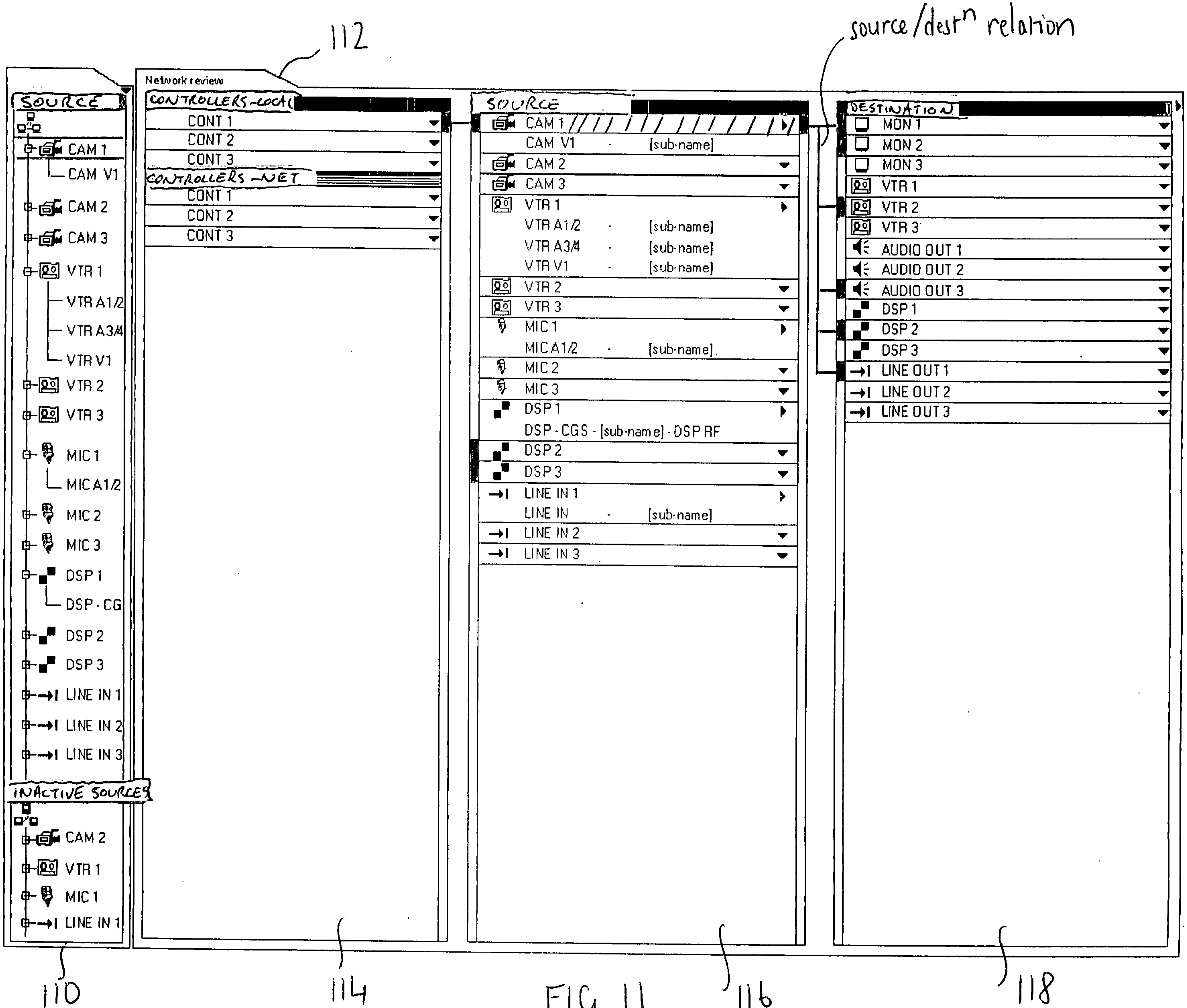
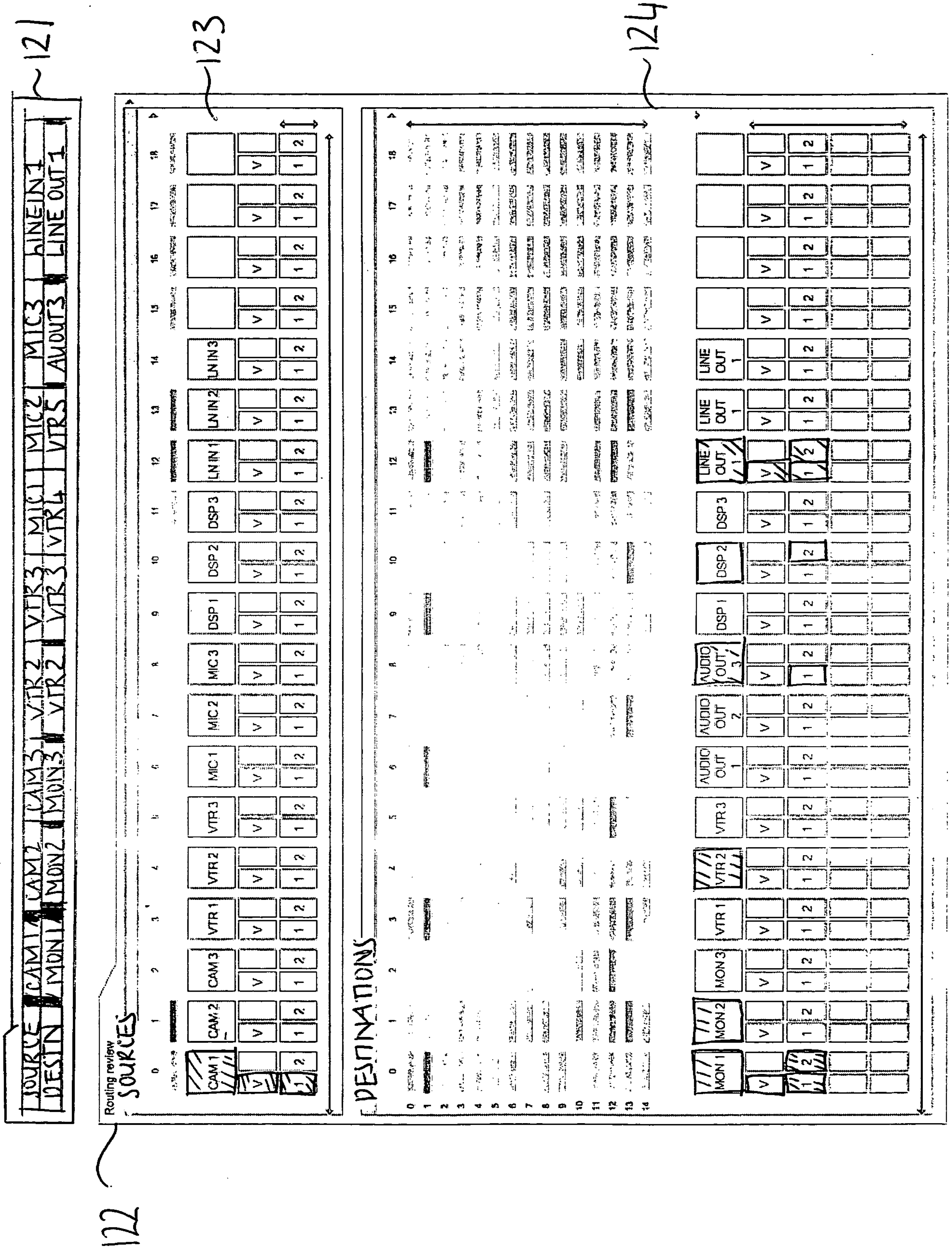

source/destn relation
112
Network review
SOURCE
CAM 1
CAM V1
CAM 2
CAM 3
VTR 1
VTR A1/2
VTR A3/4
VTR V1
VTR 2
VTR 3
MIC 1
MIC A1/2
MIC 2
MIC 3
DSP 1
DSP - CG
DSP 2
DSP 3
LINE IN 1
LINE IN 2
LINE IN 3
INACTIVE SOURCES
CAM 2
VTR 1
MIC 1
LINE IN 1
CONTROLLERS - LOCAL
CONT 1
CONT 2
CONT 3
CONTROLLERS - NET
CONT 1
CONT 2
CONT 3
SOURCE
CAM 1
CAM V1 - [sub-name]
CAM 2
CAM 3
VTR 1
VTR A1/2 - [sub-name]
VTR A3/4 - [sub-name]
VTR V1 - [sub-name]
VTR 2
VTR 3
MIC 1
MIC A1/2 - [sub-name]
MIC 2
MIC 3
DSP 1
DSP - CGS - [sub-name] - DSP RF
DSP 2
DSP 3
LINE IN 1
LINE IN - [sub-name]
LINE IN 2
LINE IN 3
DESTINATION
MON 1
MON 2
MON 3
VTR 1
VTR 2
VTR 3
AUDIO OUT 1
AUDIO OUT 2
AUDIO OUT 3
DSP 1
DSP 2
DSP 3
LINE OUT 1
LINE OUT 2
LINE OUT 3
110
114
116
118

FIG 11



121
122
123
124
SOURCE
DESTN
CAM 1
CAM 2
CAM 3
VTR 2
VTR 3
MIC 1
MIC 2
MIC 3
LINE IN 1
MON 1
MON 2
MON 3
VTR 4
VTR 5
AUDOUT 3
LINE OUT 1
Routing review
SOURCES
DESTINATIONS
VTR 1
DSP 1
DSP 2
DSP 3
LN IN 1
LN IN 2
LN IN 3
AUDIO OUT 1
AUDIO OUT 2
AUDIO OUT 3

FIG 12

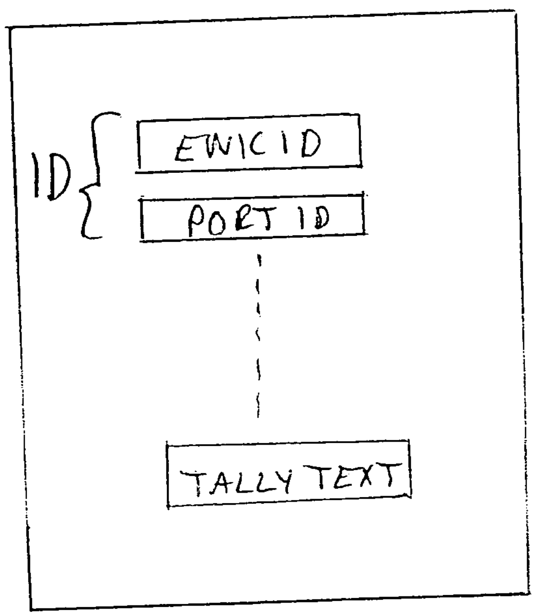
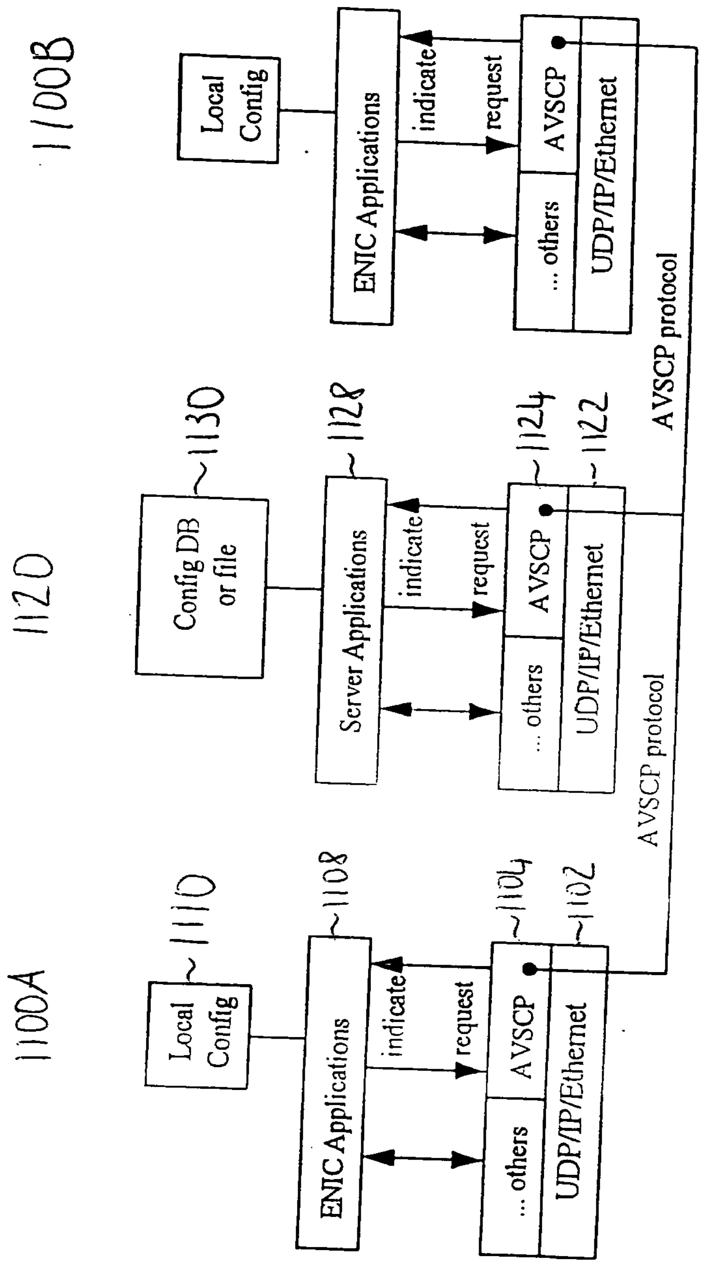


Figure 13



1100A
1100B
1120
Local Config
1110
ENIC Applications
1108
indicate
request
AVSCP
1104
... others
UDP/IP/Ethernet
1102
Config DB or file
1130
Server Applications
1128
1124
1122
AVSCP protocol

FIG 14

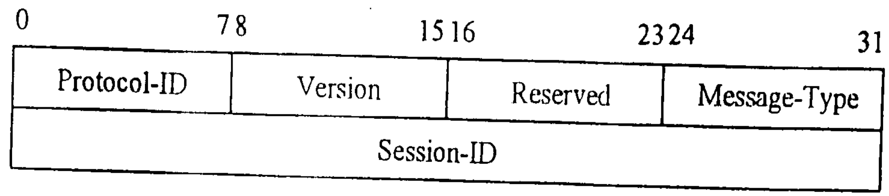

0
7 8
15 16
23 24
31
Protocol-ID
Version
Reserved
Message-Type
Session-ID

FIG 15